

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

OPIC  
OFFICE DE LA PROPRIÉTÉ  
INTELLECTUELLE DU CANADA



CIPO  
CANADIAN INTELLECTUAL  
PROPERTY OFFICE

11002 Hall KIA 0C9

(21) (A1)	2,107,277
(22)	1993/09/29
(43)	1994/05/04

(51) INTL. CL. <sup>5</sup> D21H-019/84

(19) (CA) APPLICATION FOR CANADIAN PATENT (12)

(54) Method and Apparatus for Two-Side Coating of a Thin  
Printing Paper Web Made of Mechanical Pulp

(72) Rantanen, Rauno - Finland ;  
Vikman, Kai - Finland ;

(71) Valmet Paper Machinery Inc. - Finland ;  
Metsä-Serla Paperi Ja Kartonki Oy - Finland ;

(30) (FI) 924960 1992/11/03

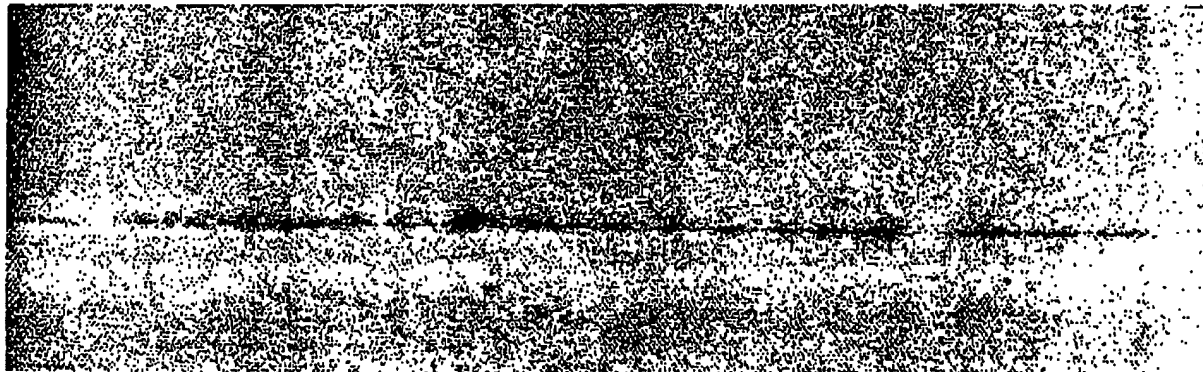
(57) 10 Claims

Notice: This application is as filed and may therefore contain an  
incomplete specification.



Industrie Canada Industry Canada

3488

**Canada**

2107277

## [57] Abstract

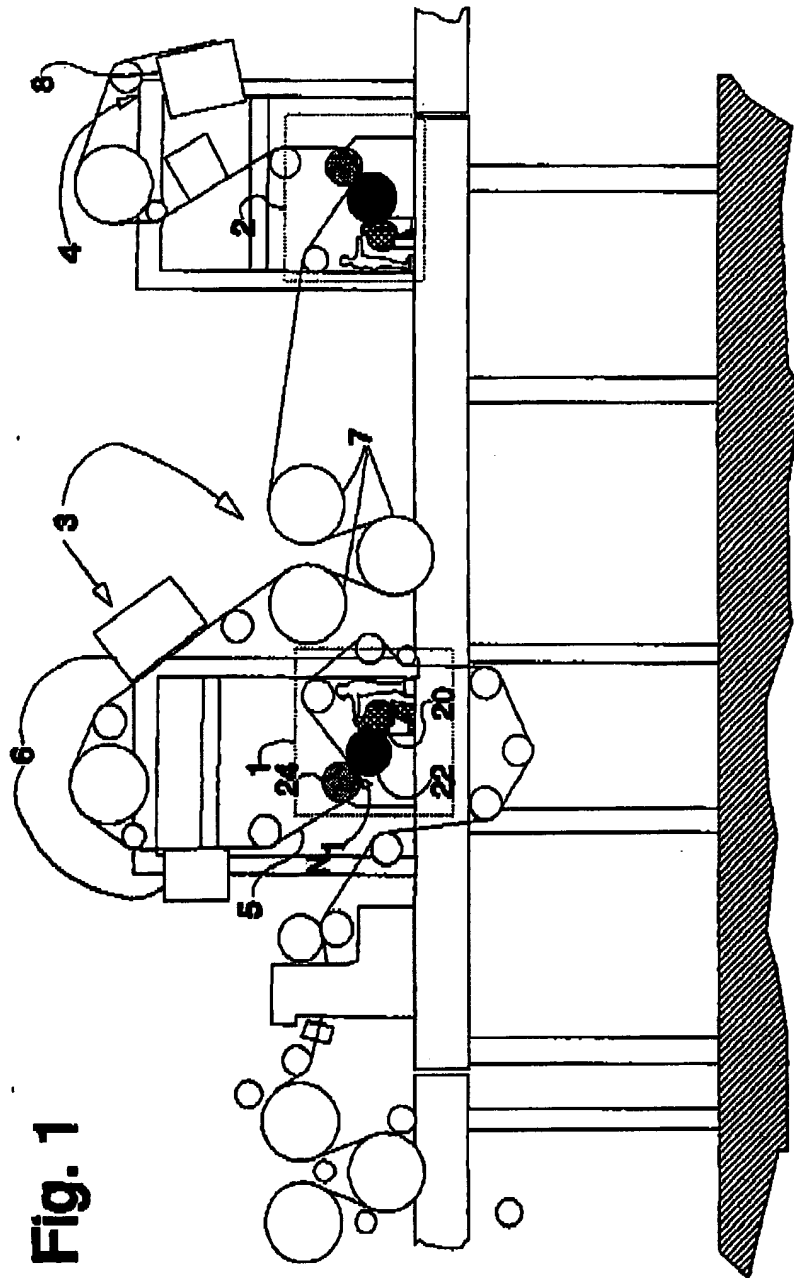
The invention relates to a method and apparatus for two-side coating of a light base weight printing paper web containing mechanical pulp or recycled fiber.

According to the method the first side of a web (5) is coated in a first coating station (1), the first-side coat is dried at least partially in a dryer unit (3), the second side of the web (5) is coated subsequent to the drying of the first side in a second coating station (2), and the second-side coat is dried at least partially in a second dryer unit (4).

According to the invention both the first-side coat and the second-side coat are formed by applying a required amount of coating mix onto the perimeter of a soft film-coating roll (22) and subsequently transferring said coat film to the web (5) in a nip (N<sub>1</sub>) formed between a backing roll (24) and said film-coating roll (22).

(Fig. 1)

2107277

**Fig. 1***Goulting, Strathy & Henderson*

2107277

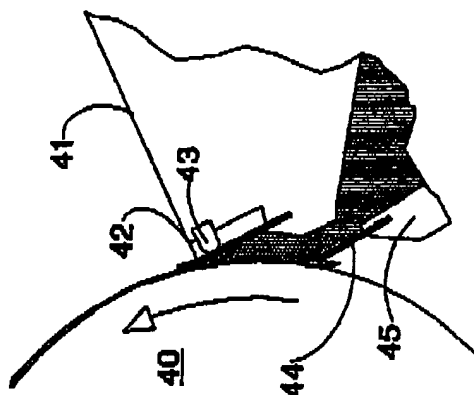


Fig. 3

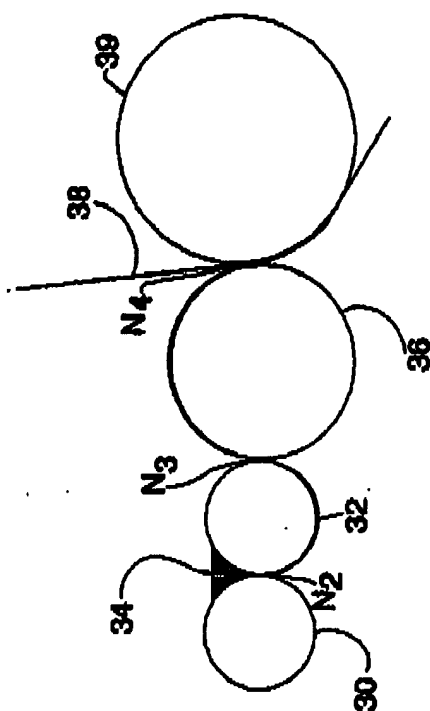


Fig. 2

Goulding, Strathy & Henderson

2107277

Method and apparatus for two-side coating of a thin  
printing paper web made of mechanical pulp

5 The present invention relates to a method according to  
the preamble of claim 1 for two-side coating of a thin  
printing paper web containing mechanical pulp, e.g., a  
paper web made of recycled fiber.

10 The invention further relates to an apparatus suited to  
two-side coating of a thin printing paper web made of  
mechanical pulp.

Thin printing paper webs containing mechanical pulp are  
conventionally coated on subsequent coating stations  
15 equipped with short-dwell coaters as the coater units.  
A combination of two subsequent coater stations is neces-  
sary as low base paper weight and high content of  
groundwood make single-run coating on both sides impos-  
sible. Two-side coating with conventional methods would  
20 excessively wet the web and thus impair its runnability.  
Furthermore, the measurement of coat weight in a two-side  
coating operation is difficult.

Despite their multiple benefits, short-dwell coaters also  
25 have several drawbacks. Air entrapped in the coat paste  
easily causes mottling. Owing to the small linear  
application pressure and short application distance,  
wetting of the base web and subsequent fiber swelling  
occurs even after the web has passed the doctor blade.  
30 This may impair the coat smoothness. As a rule, doctor  
blade coating methods become critical with thin webs and  
particularly with light coat weights.

Paper grades containing a high proportion of mechanical  
35 pulp and a high percentage of coat fillers such as, e.g.,  
SC paper (wood containing high filler content super-  
calendered printing paper) make doctor blade coating  
impossible owing to the fragility of the base paper web.

2107277

2

Web defects leading to brittleness result in low production yield and inferior runnability.

Base paper grades containing recycled fiber have posed unexpected problems in doctor blade coaters: The coat is easily marked during coating by streaks caused by defective doctor blades.

Recycled-fiber containing base paper grades have a darker color, thus making the opacifying power of the coat mix more critical. Owing to its operating principle, doctor blade coating tends to give a smooth coat, not a coat of uniform coat weight. As the base paper is not necessarily smooth, the opacifying power obtained in doctor blade coating is insufficient, resulting in mottling of the coated web.

It is an object of the present invention to overcome the disadvantages of the above-described prior-art technology and to achieve an entirely novel method and apparatus for two-side coating of a thin printing paper web containing mechanical pulp such as, e.g., a paper web grade made of recycled fiber.

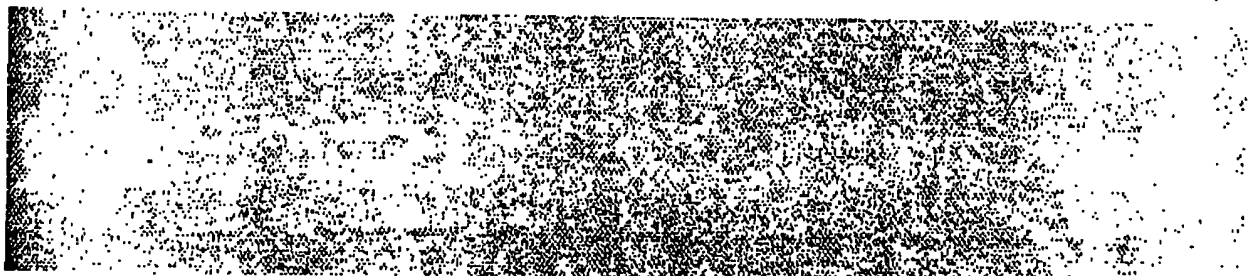
The invention is based on performing the coating operation using a two-step compressive film-lamination technique.

More specifically, the method according to the invention is principally characterized by what is stated in claim 1.

Furthermore, the apparatus according to the invention is characterized by what is stated in claim 4.

35

The invention provides significant benefits.



2107277

3

The technique according to the invention halves the web wetting relative to single-run two-side coating. Thus, the invention provides good runnability. Further, good coat quality is attained at light coat weights.

- 5 Particular benefit is achieved with base paper grades containing recycled fibers as the formation of streaks associated with doctor blade coating can be avoided. Since the compressive film-lamination technique forms a coat of uniform weight on the web, the coat has a high  
10 opacifying power. For the same reason, a higher burst index relative to doctor blade coating is attained. Moreover, the measurement of coat weight by means of rupturing testers is easy. The method according to the invention imposes minimal mechanical stress on the web.
- 15 Two-side single-run coating requires a long path of unsupported pulling of the web prior to the web support roll to give the coat a possibility of drying prior to touching the support roll. In the technique according to the invention, the uncoated side can be supported by a  
20 roll immediately after the coating of the other side, thus achieving a significant reduction in coater unit size.

- In the following the invention is described in greater  
25 detail with the help of exemplifying embodiments illustrated in the annexed drawing in which

Figure 1 is a side elevation view of a part of a paper machine incorporating a coater apparatus according to the  
30 invention.

Figure 2 shows diagrammatically an alternative coater apparatus according to the invention.

- 35 Figure 3 shows in greater detail a nozzle assembly suited to implement the coater apparatus according to the invention.





2107277

4

In conjunction with the present invention, the term compressive film-lamination technique is used to refer to a technique in which the web during coating is subjected to a linear pressure in a nip formed between a film-coating roll and a backing roll so as maintain the peripheral speeds of both the film-coating roll and the backing roll approximately equal to the web speed.

In conjunction with the present invention, the term light web material refers to web materials having a base weight of less than 65 g/m<sup>2</sup>.

With reference to Fig. 1, the apparatus according to the invention comprises a first compressive film-lamination station 1 and a second compressive film-lamination station 2, having a first drying unit 3 placed between them. The web path is configured so that subsequent to the first drying unit 3 on the path of a web 5 is placed the second coating station 2, followed by a second drying unit 4. Basically, both drying units have a similar construction. The coating station 1 is comprised of a film-coating roll 22, a coater bar 20 and a backing roll 24 of the film-coating roll 22. The coater bar 20 serves for metering a desired amount of coating mix onto the film-coating roll 22, wherefrom the coating mix is subsequently transferred in the nip N<sub>1</sub> to the web 5. To make the coating mix adhere to the web with the greatest smoothness free from orange peel effect, the backing roll 24 has advantageously a smaller diameter than the film-coating roll, whereby the angle at which the web 5 conforming to the backing roll 24 exits the nip N<sub>1</sub> is maximized. In an alternative approach the web 5 is guided toward the film-coating roll 22, whereby also a good coat surface quality is obtained.

The first drying unit 3 is comprised of infra-red dryers 6 and dryer drums 7.



2107277

5

Basically, the coating station 2 has a similar construction to that of coating station 1. Owing to the routing of the web 5, the station 1 is mirrored from station 2. The station 2 is analogously followed by the  
5 second drying unit 4 comprising an infra-red dryer 8 with subsequent drying cylinders (not shown).

With reference to Fig. 2, the coating bar 20 can be replaced by a so-called gate roll coater in which the  
10 coating mix is transferred from a coating mix fountain 34 located above a nip  $N_2$ , which is formed by a transfer roll 30 and a metering roll 32, via said nip  $N_2$  onto the perimeter of said metering roll 32 and further via a nip  $N_3$  onto the perimeter of a film-coating roll 36. From the  
15 perimeter of the film-coating roll 36 the coating mix is applied to a web 38 in a nip  $N_4$  formed between the film-coating roll 36 and a backing roll 39. According to the invention, the diameter of the backing roll 39 can be smaller than the diameter of the film-coating roll 36.

20 The film-coating roll 36 has a diameter of 1000 mm typical, and the backing roll 39 has a diameter of 800 mm, respectively.

25 Characterizingly, in both above-described exemplifying embodiments the surface of the film-coating roll is adjusted to carry an approx. 7...15  $\mu\text{m}$  thick film of the coating mix, a major portion (typically approx. 80 %) of which is adhered to the web in the nip between the film-coating roll and the backing roll. Thus, the web is  
30 coated with a coat of 7...15  $\text{g/m}^2$  dry weight.

The adsorption of the coating mix paste and the water contained therein is related to the magnitude of the nip  
35 pressure and the duration of said pressure, that is, the width of the nip. On the other hand, the nip width is solely determined by the diameters of the rolls and their

2107277

6

hardness, while the magnitude of the nip pressure is principally determined by the linear loading of the nip, and additionally, by the web speed. Accordingly, the good penetration of the coat into the web is achieved by means of a high linear application pressure imposed in a relatively wide nip.

The maximum nip pressure typically is 1000 kPa gauge and the nip width is in excess of 15 mm. Good results according to the invention have been obtained by keeping the nip pressure above 500 kPa and the nip width greater than 10 mm. Such desirable nip widths can be attained by means of hard rolls with diameters in excess of 600 mm. Particularly the film-coating roll must have a diameter greater than 600 mm, whereby the backing roll must also have a diameter in excess of 600 mm. To achieve the minimum pressure limit of 500 kPa, the linear nip loading must be at least 20 kN/m for a typical coating mix paste. In conventional kiss roll coating, the application pressure is only approx. 50...100 kPa, while a conventional doctor blade coater can achieve a pressure of 1000 kPa over a nip width of less than 1 mm. In a conventional short-dwell coater the encountered levels of application pressure are yet lower. The technique according to the invention is suited to web speeds of 400...1500 m/min typical. The linear nip loading is typically in the range of 20...50 kN/m, advantageously approx. 35 kN/m. The coating material of both the backing roll 7 and the film-coating roll 4 is polyurethane, rubber or any suitable resilient material. The P&J numbers of the rolls are typically in the range of approx. 0...40. The film-coating roll employed in the embodiments according to the invention is invariably a so-called soft roll with a surface material of polyurethane, for instance.

2107277

7

With reference to Fig. 3, a nozzle assembly for a film-coating roll 40 is comprised of a coater blade 42 tilted to an acute angle and mounted to a frame structure 41. Between the frame structure 41 and the blade 42 is placed  
5 a loading hose 43 suited to controlling the linear pressure and position of the blade 42. The coating mix 46 is contained in a metering fountain formed between a front wall 44 and the blade 41, wherefrom the mix is transferred in a controlled manner onto the perimeter of  
10 the coating roll 40. The front wall 44 is mounted by means of support elements 45 onto the chassis of the apparatus. Such a nozzle assembly is known in the art and its construction is described in greater detail in US patent 4,839,201, for instance. The blade 42 can  
15 alternatively be replaced by a doctoring bar.

In a preferred embodiment of the invention the backing roll has a metal surface. The metal surface can be of chromium, for instance. Also ceramic or polymer covered  
20 backing rolls are usable. A metal or ceramic covered backing roll performs initial calendering of the coated web. Such coated rolls with a steel core can also be provided with chilling, whereby condensation of moisture onto the roll perimeter is attained, which in turn aids  
25 keeping the roll clean. Owing to the improved thermal and wear resistance of a metal or ceramic covered roll, also steam and scraper blades can be used for keeping the rolls clean.

30 According to the invention, the nozzle assembly employed for metering the coating mix onto the film-coating roll can also be a slot-orifice die metering assembly or a spraying apparatus capable of spraying the coating mix onto the roll surface.

E

2107277

8

The table below gives exemplifying compositions of coating mixes suited for advantageous use according to the invention:

5	Coating color component	Coating mix composition 1	Coating mix composition 2
	Calcium carbonate pigment	100 parts	
	Kaolin pigment		100 parts
	Starch binder	10 parts	6 parts
10	Synthetic binder	4 parts	6 parts
	Additives	2 parts	0.5 parts
	Solids content	55 %	58 %
	viscosity (Brookfield 100)	500 cP	800 cP

15

2107277

9

## Claims:

1. A method for two-side coating of a light base weight printing paper web containing mechanical pulp or recycled fiber, in which method
- the first side of a web (5) is coated in a first coating station (1),
  - the first-side coat is dried at least partially in a dryer unit (3),
  - the second side of the web (5) is coated subsequent to the drying of the first side in a second coating station (2), and
  - the second-side coat is dried at least partially in a second dryer unit (4),
- wherein
- both the first-side coat and the second-side coat are formed by applying a required amount of coating mix onto the perimeter of a soft film-coating roll (22) rotated at a peripheral speed approximately equal to the speed of the web (5) and subsequently transferring said coat film to the web (5) in a nip (N<sub>1</sub>) formed between a backing roll (24) and said film-coating roll (22).
2. A method as defined in claim 1, wherein a web of 65 g/m<sup>2</sup> maximum is coated.
3. A method as defined in claim 1, wherein the backing roll (24) used is a metal-covered roll for initial calendering of the web (5).

2107277

10

4. An apparatus for two-side coating of a light base weight printing paper web (5) containing mechanical pulp or possibly recycled fiber, said apparatus comprising

- 5       - a first coating station (1) for coating the first side of a web (5),
- a first dryer unit (3) for drying said web,
- 10       - a second coating station (2) for coating the second side of said web (5), and
- a second dryer unit (4) for drying said web (5),

15   wherein

- both the first and the second coating station (1, 2) comprise
- 20       - a soft film-coating roll (22) suitable for receiving onto its perimeter a coating mix film of desired thickness and said roll being rotatable at a peripheral speed approximately equal to the web speed,
- 25       - coating mix application means (20) suitable for metering a coating mix film onto the perimeter of said film-coating roll (22), and
- 30       - a backing roll (24) capable of forming a nip ( $N_1$ ) with the film-coating roll (22) and said backing roll (24) being rotatable at a peripheral speed approximately equal to the web speed, whereby the web (5) can be routed
- 35       through said nip ( $N_1$ ).

2107277

11

5. An apparatus as defined in claim 4, wherein the backing roll (24) is metal-covered for initial calendaring of the web (5).
- 5 6. An apparatus as defined in claim 4, wherein the backing roll (24) is ceramic-covered for initial calendaring of the web (32).
7. An apparatus as defined in claim 4, wherein the  
10 backing roll (24) is polymer-covered for initial calendaring of the web (32).
8. An apparatus as defined in claim 4, wherein the backing roll (24) is provided with chilling means.
- 15 9. An apparatus as defined in claim 4, wherein the backing roll (24) is provided with steam cleaning means.
10. An apparatus as defined in claim 4, wherein the  
20 backing roll (24) is provided with scraper cleaning means.